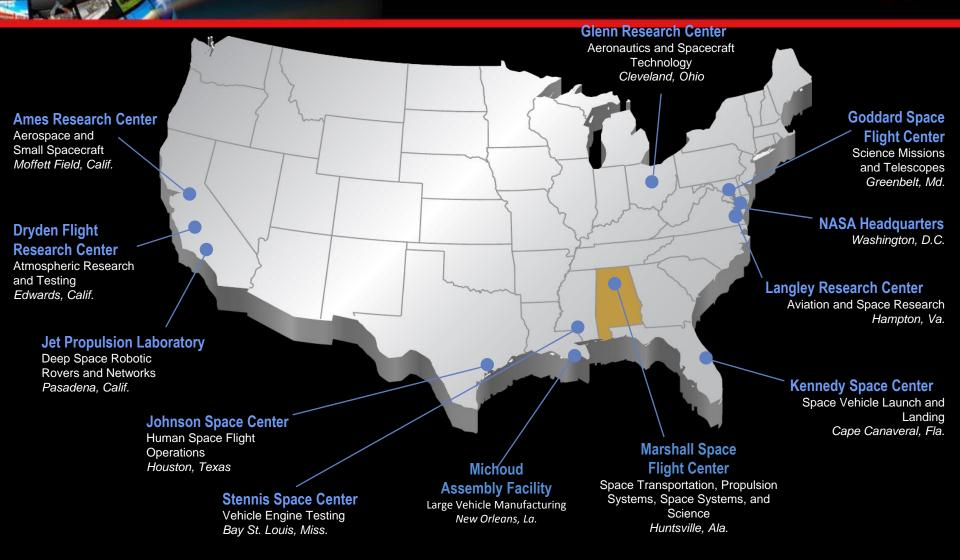


NASA Around the Country





The National Aeronautics and Space Administration











Materials and Manufacturing are Critical to all NASA Mission Areas

Space Technology...

.... an Investment for the Future

NASA

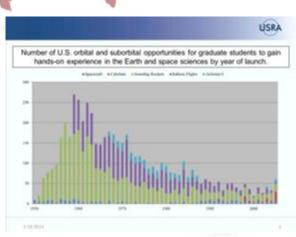
- Enables a new class of NASA missions beyond low Earth Orbit.
- Delivers innovative solutions that dramatically improve technological capabilities for NASA and the Nation.
- Develops technologies and capabilities that make NASA's missions more affordable and more reliable.
- Invests in the economy by creating markets and spurring innovation for traditional and emerging aerospace business.
- Engages the brightest minds from academia in solving NASA's tough technological challenges.

Value to NASA Value to the Nation



Addresses National Needs

A generation of studies and reports (40+ since 1980) document the need for regular investment in new, transformative space technologies.



Who:

The NASA Workforce
Academia
Small Businesses
The Broader Aerospace
Enterprise



Technology Path to Pioneering Space



Asteroid Retrieval Mission Hypersonic Inflatable Aerodynamic Decelerator

Optical Communications

LAND

LIVE



Low-Density Supersonic Decelerator

Environmental Control & Life Support System

Surface Power

Next Generation Spacesuit



In-Situ Resource Utilization

nasa.gov

Enabling Future Exploration Missions



Space Technology will focus investments in 8 thrust areas that are key to future NASA missions and enhance national space capabilities.

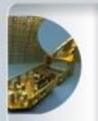


High Power Solar Electric Propulsion

Deep space human exploration, science missions with investments in advanced solar arrays and advanced electric propulsion systems, high-power Hall thrusters and power processing units.

Application:

Improved
Affordability of
commercial and
OGA Satellites



Space Optical Comm

Substantially increase available bandwidth for near Earth space communications currently limited by power and frequency allocation limits. Increase communications throughput for deep space missions.

Application: More bandwidth for Commercial and OGA Satellites



Advanced Life Support & Resource Utilization

Technologies for human exploration mission including Mars atmospheric In-situ resource utilization, near closed loop air revitalization and water recovery, EVA gloves and radiation protection.

Application: Air Revitalization for Mining Industry & other closed environments



Mars Entry Descent & Landing Systems

Permits more capable science and future human missions to Mars. Includes, hypersonic and supersonic aerodynamic decelerators, nextgen TPS materials, retro-propulsion technology, instrumentation and modeling.

Application: Returning research from ISS and other assets from space



Space Robotic Systems

Creates future humanoid robotics, autonomy and remote operations technologies to substantially augments the capability of future human space flight missions.

Application: Human safe Robotics for industrial use, Disaster Response, and Autonomous Operations



Lightweight Space Structures

Targets substantial increases in launch mass, and allow for large decreases in needed structural mass for spacecraft and in-space structures.

Application: Industrial Materials and Composites for large transportation structures



Deep Space Navigation

Allows for more capable science and human exploration missions using advanced atomic clocks, x-ray detectors and fast light optical gyroscopes.

Application: Next Generation GPS & launch vehicles



Space Observatory Systems

Allows for significant gains in science capabilities including: coronagraph technology to characterize exoplanets, advances in surface materials and better control systems for large space optics.

Application: Industrial Materials, Earth Observation

Space Technology Portfolio



Transformative & Crosscutting Technology Breakthroughs Pioneering Concepts/Developing Innovation Community

Creating Markets & Growing Innovation Economy

Technology Demonstration

Missions bridges the gap between early proof-of-concept tests and the final infusion of cost-effective, revolutionary technologies into successful NASA, government and commercial space missions.



Small Spacecraft Technology Program

develops and demonstrates new capabilities employing the unique features of small spacecraft for science, exploration and space operations.



Center Innovation Fund

NASA Innovative

Concepts (NIAC) nurtures

future NASA missions with the

better or entirely new aerospace

innovators and entrepreneurs as

partners in the journey.

visionary ideas that could transform

creation of breakthroughs—radically

concepts-while engaging America's

Advanced

stimulates and encourages creativity and innovation within the NASA Centers by addressing the technology needs of the Agency and the Nation. Funds are invested to each NASA Center to support emerging technologies and creative initiatives that leverage Center talent and capabilities.



Space Technology Research Grants seek to

accelerate the development of "push" technologies to support future space science and exploration needs through innovative efforts with high risk/high payoff while developing the next generation of innovators through grants and fellowships.



Centennial Challenges

sources advancing technologies of

directly engages nontraditional

value to NASA's missions and to

the aerospace community. The

program offers challenges set up

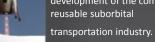
as competitions that award prize

money to the individuals or teams

that achieve a specified

Flight Opportunities

facilitates the progress of space technologies toward flight readiness status through testing in space-relevant environments. The program fosters development of the commercial reusable suborbital





innovative/high impact capabilities and technologies that may lead to entirely new approaches for the Agency's broad array of future space missions.





Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs

provide an opportunity for small, high technology companies and research institutions to develop key technologies addressing the Agency's needs and developing

the Nation's innovation economy.



Space Technology Research Grants

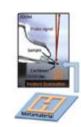


Engage Academia: tap into the talent base, challenging faculty and graduate students to examine the theoretical feasibility of ideas and approaches that are critical to making science, space travel, and exploration more effective, affordable, and sustainable.



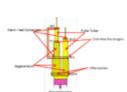
NASA Space Technology Research Fellowships

 Graduate student research in space technology; research conducted on campuses and at NASA Centers and not-for-profit R&D labs



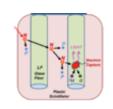
Early Career Faculty

 Focused on supporting outstanding faculty researchers early in their careers as they conduct space technology research of high priority to NASA's Mission Directorates

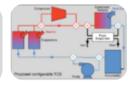


Early Stage Innovations

- University-led, possibly multiple investigator, efforts on early-stage space technology research of high priority to NASA's Mission Directorates
- Paid teaming with other universities, industry and non-profits permitted



Reinvigorate the pipeline of high-risk/high-payoff low-TRL space technologies



































Strategic Planning



- NRC Roadmaps and Strategic Space
 Technology Investment Plan Updates
- STMD Strategic Implementation Plan
- Objectives and Principles
- Balance across TRL/Programs and technology areas
- Continue to have competed and guided projects with centers, industry and academia
- Collaborations with other government agencies
- Public Private Partnerships





The Budget Process







House submits budget Draft

Senate submits budget Draft



House and
Senate
must agree
and pass a
budget
resolution



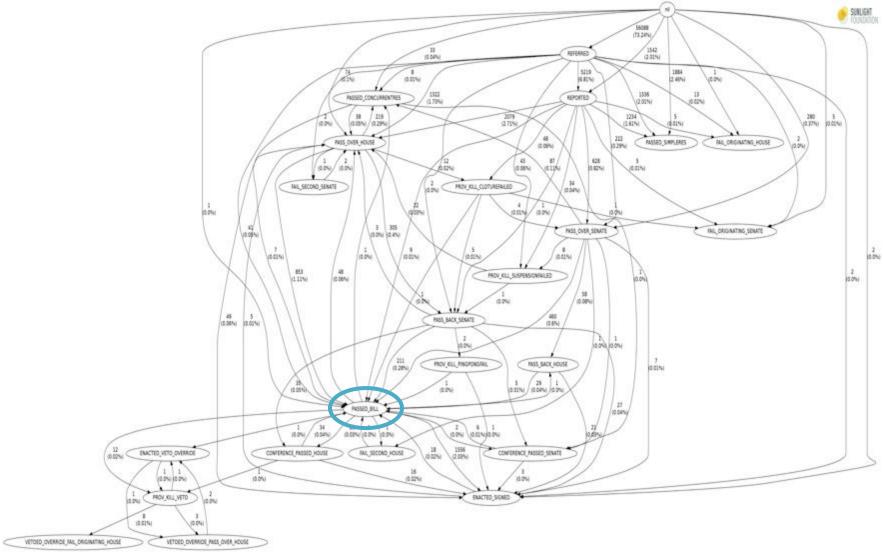
Congress authorizes budget for NASA Congress appropriates budget for NASA

President signs final budget



The Budget Process - Really





Interagency Advanced Manufacturing National Program Office (AMNPO)





Executive Office of the President

























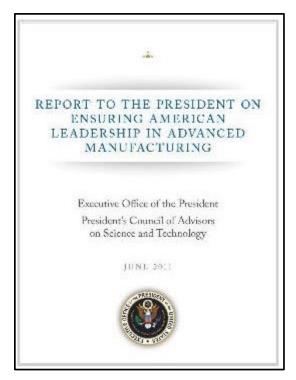


Advanced Manufacturing Partnership (AMP/PCAST)

Advanced Manufacturing
National Program Office
(hosted by DOC - NIST)

NSTC - Advanced Manufacturing Subcommittee

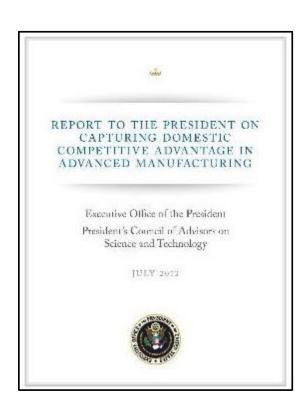
PCAST: The Independent Basis of NNMI President's Council of Advisors on Science and Technology



PCAST 2011

Recommends Advanced

Manufacturing Initiative as national
innovation policy

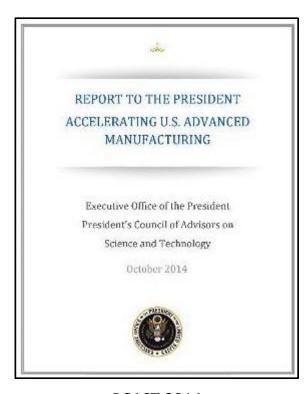


PCAST 2012

Recommends Manufacturing

Innovation Institutes to address

key market failure



PCAST 2014

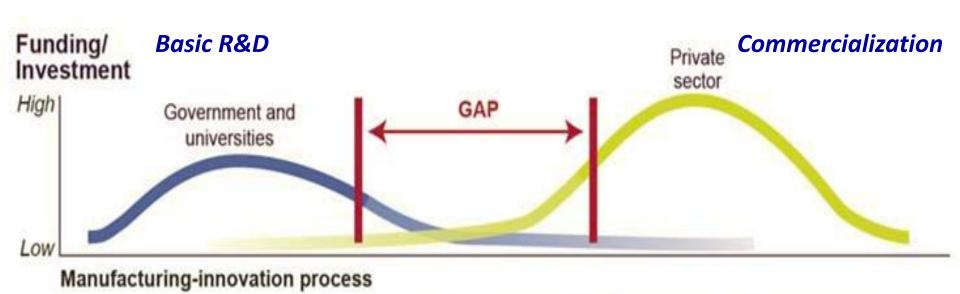
Recommends strong, collaborative network of Manufacturing

Innovation Institutes

NNMI: Addressing the "Scale-up" Gap



Focus is to address market failure of insufficient industry R&D in the "missing middle" or "industrial commons" to de-risk promising new technologies



Capacity to

produce

prototype

Capability in

production

environment

Demonstration

of production

rates

Production

laboratory

Basic

manufacturing

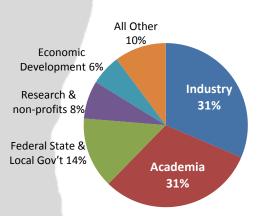
research

Proof of

concept

Public Engagement on Design Workshops & Request for Information





Broad & Diverse Stakeholder Input 1,200 voices on the NNMI Design!



University of Colorado Boulder, Colorado







Rensselaer Polytechnic Institute **Troy New York**



Cuyahoga Community College Cleveland Ohio

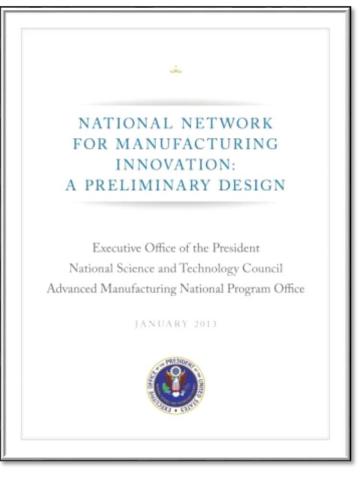
Huntsville, Alabama

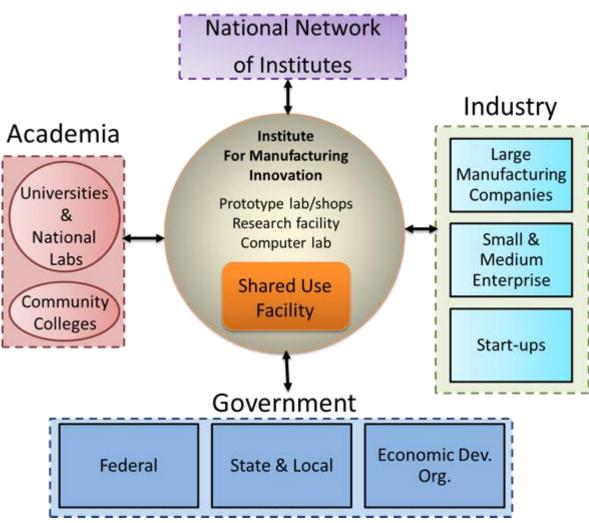


National Academies Beckman Center Irvine California

The Institute Design Creating the space for Industry & Academia to collaborate







The Institute Summary



Applied Research + Education/Workforce Skills + Development of Future "Manufacturing Hubs"

The Federal investment in the National Network for Manufacturing Innovation (NNMI) serves to create an effective manufacturing research infrastructure for U.S. industry and academia to solve industry-relevant problems. The NNMI will consist of linked Institutes for Manufacturing Innovation (IMIs) with common goals, but unique concentrations. In an IMI, industry, academia, and government partners leverage existing resources, collaborate, and co-invest to nurture manufacturing innovation and accelerate commercialization.

As sustainable manufacturing innovation hubs, IMIs will create, showcase, and deploy new capabilities, new products, and new processes that can impact commercial production. They will build workforce skills at all levels and enhance manufacturing capabilities in companies large and small. Institutes will draw together the best talents and capabilities from all the partners to build the proving grounds where innovations flourish and to help advance American domestic manufacturing.

Federal startup investment: \$70M - \$120M/institute over 5-7 years Institute Consortium owners must have minimum 1:1 co-investment

The NNMI Mission



"The Network serves the Institutes, the Institutes connect through the Network, and the Program serves the Nation."

Program Mission (Institutes + Network)

Advance American domestic manufacturing innovation by creating an effective manufacturing research and development infrastructure for U.S. industry and academia to solve industry-relevant problems.

Institute Mission

Create and strengthen American manufacturing hubs through sustainable industry-led innovation institutes that create, showcase, and deploy new capabilities.

Network Mission

Maximize the integrated impact of the manufacturing innovation institutes on U.S. manufacturing competitiveness.



Institute of Advanced Composites Manufacturing Innovation

Advanced Composites Institute Profile



IACMI, The Composites Institute Knoxville, TN Launched June 16, 2015

Agency sponsor: DOE

Startup funding: \$70M public,

\$159M co-investment

+344,000 square feet in five core regions manufacturing, laboratory, instructional collaboration space





1) Clear, unique Institute Focus



Each Institute has a clear mission based on a critical Industry need

Opportunity

Lightweight composites offer benefits to energy efficiency and renewable power generation, overcoming limitations through deployment of advanced technologies to make composite lower cost, faster, using less energy that can be readily recycled offer tremendous opportunities for US manufacturers.

Big Idea

The Institute will provide access to world-class resources to partner with industry and develop new low-cost, high-speed, and efficient manufacturing and recycling process technologies that will promote widespread use of advanced fiber-reinforced polymer composites.

At the new Institute, a world-class team of organizations from leading industrial manufacturers, material suppliers, software developers, government and academia will focus on lowering the overall manufacturing costs of advanced composites by 50 percent, reducing the energy used to make composites by 75 percent, and increasing the ability to recycle composites by more than 95 percent within the next decade.

2) Clear Industry Value Proposition



Each Institute creates value for industry participation and funding

- Access to Shared RD&D Resources: Leverage and provide access to equipment from lab to full-scale to enable demonstration and reduce risk for industry investment
- Applied R&D: Leverage significant government, industry, and academic investments to develop innovative solutions to member challenges
- Composites Virtual Factory: Provide access to end to end commercial modeling and simulation software for composite designers and manufacturers through a web based platform.
- Workforce Training: Provide specialized training to prepare current and future workforces for the latest manufacturing methods and technologies







3) Strong Private-Public Partnership



Each Institute is operated by a consortium; serving a partnership of Industry, Academia and government







4) Addressing Critical Challenges



By workshops and Technology Roadmaps, Each Institute works on the industry priorities and big challenges only solvable by collaboration



Five/Ten Year Technical Goals

- 25/50% lower carbon fiber—reinforced polymer (CFRP) cost
- 50/75% reduction in CFRP embodied energy
- 80/95% composite recyclability into useful products



Impact Goals

- Enhanced energy productivity
- Reduced life cycle energy consumption
- Increased domestic production capacity
- Job growth and economic development

5) Balanced Portfolio of Projects

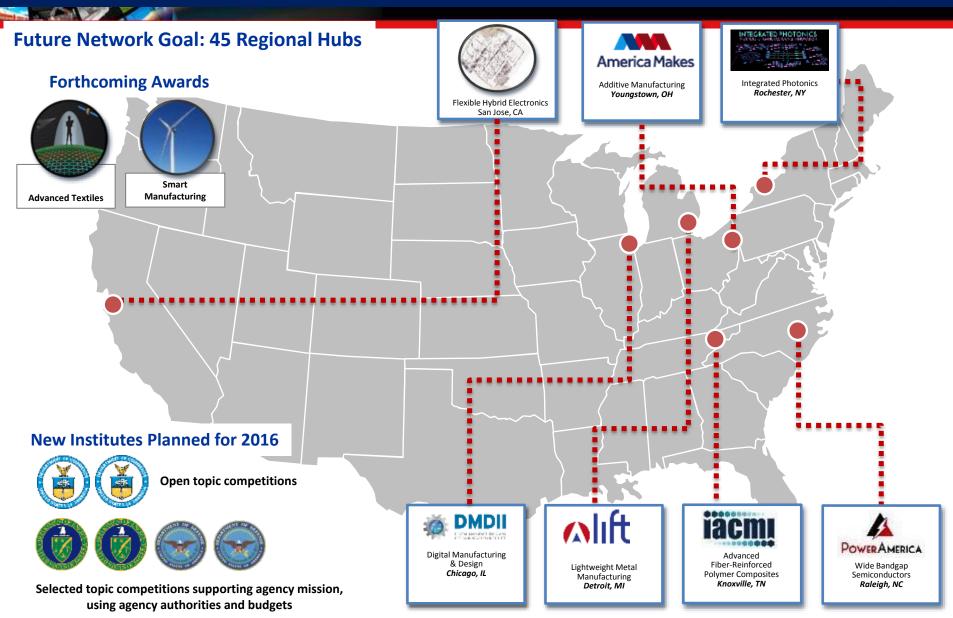


From Technology Roadmaps and Strategic Investment Plan, Each Institute manages a balanced portfolio of real projects for Industry

a balanced portfolio of real projects for Industry	
Activity	Result
1. First Projects Identified in proposal to DOE	 Strengthen infrastructure capacity: Materials and processing - Modeling and simulation Innovation and workforce development in strategic areas with national benefit: Automotive - Wind - Compressed gas storage
2. Technology Roadmap Driven by IACMI CTO, Industry and Technology Advisory Board	 Identifies key hurdles to high -impact, large scale advanced composites manufacturing Prioritizes opportunities across the materials and manufacturing supply chain
3. Strategic Investment Plan Driven by IACMI BOD and Technical Advisory Board	Changing the innovation cycle to enable rapid adoption and scale-up of advanced composites manufacturing
4. Open Project Call	 Aligns with strategic investment plan and technology roadmap Emphasis on projects with high near term impact. Project Call- open NOW

• Project Call- open NOW

Building the Network Network Status and FY16 Plans



DOD RFI for next Institute Topics



Asking for information on selecting next institute topics - Responses Due February 16th

- Assistive and Soft Robotics
- Advanced Machine Tools and Control Systems
- Securing the Manufacturing Digital Thread –
 Cybersecurity for Manufacturing
- Bioengineering for Regenerative Medicine
- Bioprinting across Technology Sectors
- Certification, Assessment and Qualification
- Open topic (RFI responders may suggest)

Commerce/NIST Institutes "Open Topic" Competition



Uses new authorities under the Revitalize American Manufacturing and Innovation Act (RAMI) -

Proposals will be accepted on **any topic** not already covered by existing NNMI institutes

- Key attributes
 - Open topic competition
 - Up to \$70 M federal share per Institute
 - Each institute to serve as a regional hub with well-defined focus area
 - Two-step process, Pre-Applications then Invited Full
 Applications each step to be open no less than 60-days

Recent-NNMI Reports





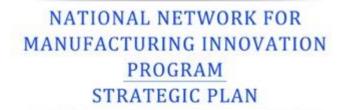
ANNUAL REPORT

Executive Office of the President National Science and Technology Council Advanced Manufacturing National Program Office

February 2016



First Annual Report on the NNMI Program



Executive Office of the President National Science and Technology Council Advanced Manufacturing National Program Office

February 2016



First Strategic Plan on the NNMI Program

NNMI: Enabling a Manufacturing Renaissance Accelerating Discovery to Application to Production



- Establish a presence, at scale, in the "missing middle" of advanced manufacturing research
- Create an Industrial Commons, supporting future "manufacturing hubs", with active partnering between all stakeholders
- Emphasize/support longer-term investments by industry
- Combine R&D with workforce development and training
- Overarching Objective: Unleash new U.S. advanced manufacturing capabilities and industries for stronger global competitiveness and U.S. economic & national security



DESIGNING NEW MATERIALS IN THE FUTURE

